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Antibiotic resistance pattern of *Staphylococcus aureus* isolated from nostrils of healthy undergraduates of Madonna University Elele Campus, Rivers State, Nigeria

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ABSTRACT

Background: Antimicrobial resistance is a global health issue with particular concern in developing countries, where there are poor antibiotic regulatory policies. *Staphylococcus aureus (S. aureus)* has become a persistent nosocomial and community-acquired pathogen that has become a global menace**.** This study determined the prevalence and resistance patterns of nasal *S. aureus* isolated from healthy students of Madonna University, Elele Campus, Nigeria. **Methods:** One hundred and fifty nasal specimens of healthy students were cultured and screened for *S. aureus* using standard microbiological protocols and their antibiotic profile susceptibility was investigated using the disc diffusion method according to the Clinical and Laboratory Standards Institute on Mueller Hinton agar. **Results:** A total of 78 (52%) *S. aureus* isolates were obtained from 150 specimens screened. The pattern of *S. aureus* resistance to the antibiotics varied in prevalence by agent in the descending order as follows; cefuroxime = ceftazidime > cloxacillin > erythromycin > augmentin > ofloxacin > ceftriaxone > gentamicin. The isolates showed an overall 100% resistance to ceftazidime and cefuroxime. Gentamicin, ceftriaxone, and ofloxacin recorded a susceptibility rate of 98.7%, 89.7%, and 79.5% respectively. **Conclusion:** This study reveals a high prevalence of *S aureus* colonization in students in the study area. Also, these isolates could still be treated with gentamicin, ceftriaxone, and fluoroquinolones. However, there is increasing resistance to commonly prescribed antibiotics. There is a need for stringent strategies in the control of antibiotic misuse and resistance.

Introduction

Staphylococcus aureus (*S.aureus*) is a Gram-positive, coagulase-positive bacterium found on the skin and in the nose of most healthy people [1]. The nose is one of the few openings that bacteria have free passage to get inside the body. Thus, the nose and nasal passages can be a perfect environment for some bacterial communities to thrive. *Staphylococcus aureus* is known as normal flora in the skin and occasionally carried by over 60% of the world's population during their lifetime, without it causing any harm [2]. However, it is considered an opportunistic pathogen for humans and animals if found in the bloodstream and tissues. Over the past decades, *S. aureus* has been recognized as one of the most

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important bacterial pathogens which significantly contribute to hospital and community-acquired infections all over the world [1,3-5]. It is found to cause various illness ranging from minor skin infections such as pimples, impetigo, boils, cellulitis, scalded skin syndrome, folliculitis, furuncles, carbuncles, and abscesses, to life-threatening diseases such as pneumonia, osteomyelitis, meningitis, Toxic Shock Syndrome, endocarditis and septicemia [4].

Infections caused by *S. aureus* are worrisome, because of its intrinsic virulence, its ability to adapt to various environmental conditions, and ease in the acquisition of resistance to new drugs [6]. Recently, many isolates of *S. aureus* have evolved, and displayed resistance to traditional antimicrobial chemotherapy and their prevalence outside the hospital is of potential epidemiological threat. Resistance to commonly available and affordable antibiotics pose a major concern in the management of bacterial infections, especially in developing countries [7,8]. Lack of concern or good judgment in the use of antibiotics in human medicine, and for prophylaxis in animal husbandry contribute greatly to the emergence of multidrug-resistant (MDR) strains.

In several studies worldwide, *S. aureus* from normal flora seems to constitute an important reservoir of antimicrobial resistance genes [1,8-10], which can be transferred to other microbial pathogens, thus, propagating the resistance traits among microbial populations [11]. The prevalence of antibiotic-resistant *staphylococci* at various skin sites in both healthy and hospitalized patients have received much attention because of the role of these organisms as nosocomial pathogens, especially in an immune-compromised host [8].

The World Health Organization (WHO) in 2014, reported significant gaps in antibiotics surveillance, absence of standards methodology, data sharing, and coordination. According to the report, major gaps were identified in Africa, South-East Asia, and the Eastern Mediterranean regions [12]. Data on the frequency of nasal carriage, and *S. aureus* resistance to antibiotics in Elele is not known. The indiscriminate use of antibiotics before consulting a physician for a prescription is common in Nigeria. Students are major victims, as they prefer to self-prescribe or buy cheap over-the-counter drugs, and not see a physician due to financial constraints. On the other hand, most physicians prescribe and treat patients with broad-spectrum antibiotics before or without microbiological investigations [13]. These factors are key players in the development and spread of bacterial resistance to affordable and commonly used antibiotics. Antibiotic resistance surveillance data is necessary to better inform the effective administration of antibiotic therapy, and further reduce the spread of drug resistance. Thus, this study was designed to determine the prevalence and antibacterial susceptibility profile of *S.aureus* isolated from nostrils of apparently healthy undergraduates in Elele, South-Southern Nigeria. Our results may improve antibiotic–use decisions/policies.

Materials and Methods

Sample collection

This study was conducted in the Department of Pharmaceutical Microbiology and Biotechnology Laboratory, Madonna University Elele Campus, River State. A total of one hundred and fifty (150) nasal samples were randomly obtained with sterile swab sticks from healthy undergraduates students of Madonna University Elele Campus **(Figure 1)**, Rivers State, Nigeria. An informed consent was obtained from each participant. The population comprised undergraduates, all aged between 18 and 28 years. All sampling procedures were according to the guidelines of the National Health Research Ethics Committee, Nigeria (www.nhrec.net).

Isolation and identification of *S. aureus*

Swab samples were cultured on Mannitol salt agar (Oxoid, England) and incubated for 18-24 hours at 37 ˚C. The pure culture of each isolate was obtained by the streak plate technique. Identification of isolates was performed by colony morphology, Gram staining, catalase test, and coagulase test [1]. Gram-positive, catalase, and coagulase-positive isolates were considered as *S. aureus* [1,14].

Antibiotic susceptibility testing (AST)

Antibiotic susceptibility of the isolates was determined using the modified Kirby-Bauer disc diffusion technique [11]. The isolates were briefly cultured in Mueller Hinton broth at 37 ˚C for 24 hours. A suspension of each isolate standardized to match 0.5 McFarland were inoculated onto sterile agar plates. The plates were allowed to set and the antibiotic sensitivity disc (ABTEK, India) containing; ceftazidime (CAZ) 30µg, cefuroxime (CRX) 30µg, gentamicin (GEN) 10µg, ceftriaxone (CTR) 30µg, erythromycin (ERY) 5µg, cloxacillin (CXC) 5µg, ofloxacin (OFL) 5µg, augmentin (AUG) 30µg. The plates were incubated at 37 °C for 24 hours and the resultant inhibition zone diameters (IZDs) were measured and recorded. The obtained results were

interpreted based on the guidelines of the Clinical Laboratory Standard Institute [15].

Statistical analysis

Data obtained were analyzed using Microsoft Excel (2016). Results were presented as descriptive statistics in terms of relative frequency and percentage.

Figure 1. Map of the geographical location of Elele Nigeria, the study area (Map data @2019 Google).

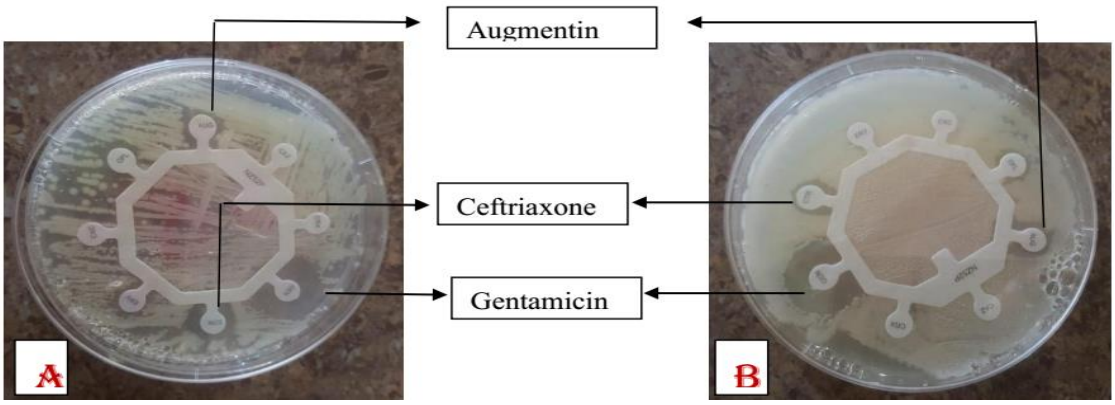
Results

The results show that seventy-eight (78) *S. aureus* strains were isolated from the one hundred and fifty (150) nasal samples screened, giving a prevalence rate of 52%. The antibiotic susceptibility pattern of *S. aureus* presented in **table (1)** shows that gentamicin, ceftriaxone, and ofloxacin had the best anti-staphylococcal activities, with only one (1) isolate resistant to gentamicin. 93% of the isolates were resistant to cloxacillin, while all the studied isolates were completely resistant to ceftazidime and cefuroxime. The prevalence rate of *S.aureus* susceptibility pattern to antibiotics obtained in this study can be summarized in descending order as follows; gentamicin (98.7%) > ceftriaxone (89%) > ofloxacin (79.5%) > augmentin (64.1%) > Erythromycin (20.5%) > cloxacillin (6.4%) >cefuroxime (0%) = ceftazidime (0%). **Figure 2** represents a comparison of the susceptibility and resistance of the isolated *S.aureus* against various antibiotics used in the study.

Table 1. Antibiotic susceptibility pattern of *S.aureus* isolated from pharmacy students of Madonna University.

Antibiotics	**Number susceptible**	**%**	**Number resistant**	**%**
Gentamicin	77	98.7	1	1.3
Ceftriaxone	70	89.7	8	10.3
Ofloxacin	62	79.5	16	20.5
Augmentin	50	64.1	28	35.9
Erythromycin	16	20.5	62	79.5
Cloxacillin	5	6.4	73	93.6
Ceftazidime	0	0	78	100
Cefuroxime	0	0	78	100

Figure 2. Plates A and B showing the susceptibility patterns of isolated *S. aureus* to the selected antibiotics. *Staphylococcus aureus* cultured on both plates were remarkably susceptible to gentamicin, ceftriaxone, and augmentin.



Discussion

The nose is known to harbor numerous and diverse groups of microorganisms. *Staphylococcus aureus* is a common bacterium carried by most people in the nose and skin and is regarded as a major risk factor for the development of infections in people. Infections caused by *S. aureus* are commonly endogenous, meaning they are caused by strains already colonizing the patient [9]. *Staphylococcus aureus* strains have been reported to cause infections in healthy people, and these infections are increasing in various regions and countries [1,5].

The carrier rate of *S.aureus* in this study was 52% which is similar to that obtained in other studies carried out in Eastern Nigeria 50%, 53%, and 56.3% [8,16,17]. However, **Nsofor et al.** [18] reported a higher *S. aureus* prevalence rate (62.9%) among school pupils in the same locality (Elele) as the study area. These results suggest a high nasal carriage of *S. aureus* among people living and residing in Elele. The *S. aureus* in this study was found to be resistant to cefuroxime, cloxacillin, and ceftazidime, but sensitive to gentamicin, ceftriaxone, and ofloxacin. Gentamicin and ceftriaxone come as injectable while ofloxacin belongs to the fluoroquinolones family. Beta lactams including penicillin derivatives and cephalosporins are commonly used antibiotics freely available in open market and other unregistered drug outlets.

This observed resistance pattern is reflective of the rate of antibiotics misuse and abuse arising from self-medications, which is often associated with inadequate dosage and failure to comply with treatments. Also, the availability of antibiotics to consumers across the counters with or without prescription. Several other researchers have also reported *S. aureus* resistance to commonly used antibiotics in community settings [16,17,19].

The observed high sensitivity of *S. aureus* to fluoroquinolones (ofloxacin) and gentamicin in this study were also observed when antibiotic susceptibility tests were conducted on healthy school pupils in Agulu, South-eastern Nigeria [19]. **Nwankwo and Nasiru** [20] reported similar antibiotic susceptibility patterns of *S. aureus* from clinical isolates in a tertiary health institution in Kano, North-west Nigeria.

It is important to note that from the *S. aureus* resistance profile results, antibiotics showing relatively good susceptibility profile (gentamicin, ceftriaxone, and ofloxacin) are agents whose antimicrobial mode of actions is based on the inhibition of protein synthesis, inhibition of cell wall synthesis and inhibition of DNA Gyrase, and are known to be generally active against Staphylococcal infections [1,21].

The increasing frequency of antimicrobial resistance among undergraduates and people in Elele is of great concern to both healthcare providers and the public. This is because the high incidence of MDR *S. aureus* in a community will make treatment of these infections more difficult [10,22].

Conclusion

Our results show the urgent need to discourage antibiotics abuse in order to prevent MDR in community-acquired staphylococcal infections. On the other hand, health sectors should base their prescriptions on proper antibiotic susceptibility results. This is important to preserve the efficacy of antibiotic drugs, and thus contain the emergence and widespread of drug resistance.

Contributors

All authors participated equally in the design, research and preparation of this manuscript.

Authorship

All authors have approved the submission of this version of the manuscript and takes full responsibility for it.

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